Optimization and Optimal Control of Energy Systems

Presented by:
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Abstract

The recent growth in urban development and in the demand for personal mobility has increased the awareness towards the need for improving the efficiency of buildings and transportation systems, reducing the energy consumption and ultimately the usage of fossil fuels. In this scenario, a strong interest is emerging in the Academic Community to advance the theory and practice in model-based optimization and control, and its application to thermo-fluid systems. The application of optimal control theory to such systems provides a unique opportunity to achieve significant improvements in the efficiency of the energy conversion process, particularly in transient conditions.

This seminar focuses on optimal control of nonlinear dynamical systems, with application to automotive climate control systems and building energy systems. Applying optimal control to energy systems poses significant challenges due to the high nonlinearities in the governing equations, as well as the multi-scale and multi-physics nature of such systems.
In this seminar, the basic theory for optimization and optimal control in nonlinear dynamical systems will be introduced, followed by selected case studies. First, an application hybrid optimal control design for an automotive air-conditioning system is presented. Then, the problem of the coordination of appliances and vehicle charging in smart homes is presented in conjunction with open issues and opportunities in this research field.

Speaker Bio:

Stephanie Stockar is a Research Associate at The Ohio State University Center for Automotive Research (OSU-CAR). She earned her BS and MS in Mechanical Engineering from the Swiss Federal Institute of Technology (ETH), Zurich in 2007 and 2010, respectively, and obtained her PhD in Mechanical Engineering from The Ohio State University in 2013. Dr. Stockar conducts research is in the areas of modeling and optimization of nonlinear dynamical systems, with focus on automotive applications (internal combustion engines, advanced powertrains) and building energy systems. Her research approach is based on the multidisciplinary integration of thermo-fluid sciences with dynamic systems, modeling, optimization and control. Dr. Stockar's work has been funded by Ford Motor Company, Fiat Chrysler Automobiles, the National Science Foundation and the US Department of Energy. Her work led to the publication of six peer-reviewed journal and thirteen conference papers. She served as Associate Editor for the IFAC Workshop on Engine and Powertrain Control, Simulation and Modeling (ECOSM) and the 2016 IFAC Advances in Automotive Control (AAC).